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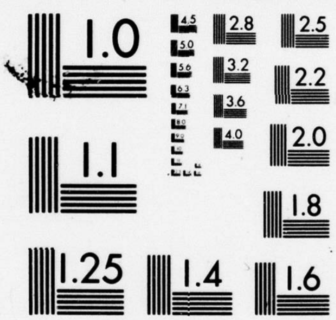

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TACTICAL COMMUNICATIONS--A PRECIOUS RESOURCE

by

Lieutenant Colonel Jack C. Hammett, Jr

Signal Corps

US ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013

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Line of sight, movement, and capacity are three key limitations of our tactical communications which inhibit the effectiveness of our combat forces today. The thrust of this paper is to examine the limitations of division-level communications and seek insight into possible solutions. The FM radio nets are efficient and responsive for broadcast traffic, but slow and inefficient for upward-flowing messages; a brigade commander may only gain access to the division command net about 4% of the time. The multichannel system is inhibited by complexity. An example illustrates that the availa- →

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bility of a typical telephone circuit may be less than 50% during periods of normal maneuver of command posts. The multichannel system is disrupted by movement; the system works during periods of stability, when we need it least, and fails during movement, when we need it most. To succeed with the existing system, we must gain an improved understanding of the limitations, and act to minimize the impact of those limitations. The suggested actions include clarifying the responsibility for communications, intensifying training, increasing discipline, simplifying the structure of command and control communications, simplifying the reporting and operational procedures, and modifying tactics to match what is possible.

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TACTICAL COMMUNICATIONS--A PRECIOUS RESOURCE

INDIVIDUAL STUDY PROJECT

by

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Line of sight, movement, and capacity are three key limitations of our tactical communications which inhibit the effectiveness of our combat forces today. The thrust of this paper is to examine the limitations of division-level communications and seek insight into possible solutions. The FM radio nets are efficient and responsive for broadcast traffic, but slow and inefficient for upward-flowing messages; a brigade commander may only gain access to the division command net about 4% of the time. The multichannel system is inhibited by complexity. An example illustrates that the availability of a typical telephone circuit may be less than 50% during periods of normal maneuver of command posts. The multichannel system is disrupted by movement; the system works during periods of stability, when we need it least, and fails during movement, when we need it most. To succeed with the existing system, we must gain an improved understanding of the limitations, and act to minimize the impact of those limitations. The suggested actions include clarifying the responsibility for communications, intensifying training, increasing discipline, simplifying the structure of command and control communications, simplifying the reporting and operational procedures, and modifying tactics to match what is possible.

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Tactical communications is the most severe limitation on the effectiveness of our combat forces today. The tactics of the "Active Defense" adds new stress on an already over-extended communications network. The frequent displacements of battalion, brigade, and division command posts decrease the connectivity of communications links. Message flow is often disrupted because the originator or the addressee is moving--and out of connection with the system. Or, the flow is cut because the intermediate (relay) node is displacing. Communications capability is dramatically decreased during movement.

The communications system works well in a stable situation, but steadily fails as the tempo of combat and maneuver increases. Our communications works when we need it least, and fails when we need it most. In this paper, we seek insight into the limitations of tactical communications.

I recently commanded the signal battalion of a mechanized division. When the battalion was trained to a peak, we could deliver decent communications during the confined movements of an on-post exercise. But the wide-ranging, almost chaotic maneuver of the 1977 REFORGER exercise produced severe failures in communications. The FM radio nets were moderately reliable, but the capacity of the nets is very limited. The multichannel links degrade with movement.

Let us consider some of the limitations of our tactical communications. We examine the division communications system and compare the strengths of nets compared to circuits. We contrast

the limitations of FM radio nets, the multichannel system, and message traffic services. We summarize the limitations in a section entitled "Tactical Communications--A Precious Resource." Finally, we turn to the question "What can we do now?" and conclude with some observations on the future.

The Division Communications System

The division communications system is a spider web of voice and teletype links that interconnect command centers. The principal radio links are of three types: FM voice, Multichannel (MChan) and Radio teletype (RATT). FM voice radios operate in several hundred nets in the division. The nets are intended to support commander-to-commander and fire support communications. The division MChan system provides twelve-channel radio links that connect brigade and division level command nodes. Switchboards at each node provide telephone access to the MChan links. RATT stations operate in several nets to provide hard copy message traffic. The MChan system and the RATT nets are intended to provide staff-to-staff communications.

The key limitations of the division communications system are line of sight (LOS), movement, and capacity. The FM and MChan radio links require LOS for reliable propagation. Terrain and foliage that obscure the LOS path between the radio antennas decrease the signal strength. Weak signals result in link failure. FM radios will operate while mobile. But telephone circuits on the MChan system only work when the command centers are stable and the wiring

is installed to connect the user's telephone to the switchboard, patch panel, and MChan radios. Movement degrades or disrupts radio links. The fixed capacity of each radio link is an obvious limitation.

Nets versus Circuits

How does the capacity of single-channel nets compare to that of telephone circuits? A contrast by type of message is shown in Figure 1. A net has the feature that only one station in the net may transmit at a time. Only one message may be conveyed at a time. A net is very efficient for short "broadcast" messages, i.e., messages that are intended for many or all of the net members. A short warning order from the G-3 may be conveyed quickly, and transmitted only once to the major commands in the net. But the net is slow and inefficient for upward-flowing (one-to-one) traffic such as spot reports. We return to a net radio example later. Because a net has very limited capacity, only the most important messages that are key to the immediate battle may be conveyed, in order of precedence. When flash or immediate traffic is in progress, the priority and routine messages must wait.

Telephone circuits have just the opposite strengths and weaknesses. A telephone circuit is a one-to-one connection between two users, so a circuit is very efficient for reports. In a stable situation, there are many telephone circuits available, so that many separate conversations (messages) may be in progress at one time. The telephone network is a very powerful resource, because the capacity is much greater than that of all the nets combined. A telephone

"Nets" vs. "Circuits"

	Type of Message	
	Broadcast ("one to many")	Report (one to one)
Net	very efficient for short messages	slow and inefficient, low capacity
Circuit	slow and inefficient	efficient, high capacity

FIGURE 1

circuit is inefficient for broadcast traffic. (The G-3 would have to call each unit, one at a time, to convey the warning order.) The availability of telephone service depends upon flawless execution by the signal battalion and upon orderly displacement of command centers.

A telephone circuit is often a more powerful method than FM voice. The circuit is two-way, so the listener may interrupt to give feedback or ask a question. The use of the circuit is conversational, with privacy; thus, informal. The FM voice link is one-way, and lacks privacy. So we tend to make short speeches to one another. A voice net is more formal and less interactive than a telephone circuit.

The radio links of FM voice nets and of the MChan telephone system share several limitations. The LOS consideration limits range. Radio links are vulnerable to enemy jamming and to unintentional interference. Propagation success depends on the operating frequency, terrain, time of day, weather, and other effects of "mother nature" that are beyond human control. Let us take a closer look at the limitations of FM radio nets and the MChan telephone system.

FM Radio Nets

The key strength of FM radio is that mobile operation is possible. Rapid installation of a ground-plane antenna at a fixed site provides improved signal strength, extending the area coverage and reliability of the station. The radio is operated by the user on a "push-to-talk" basis, responsive to his needs. FM radio range on LOS links is typically 20 km in mobile operation, 30-40 km stationary, and may be extended to 40-60 km with directional antennas.

A dominant limitation is the LOS constraint. Trees surrounding the antenna at one end of a LOS path may cut the range in half. Wet trees are even worse. A masking hill that blocks LOS drops the signal strength even further. Range may be cut to less than 4 km by trees and terrain. Operation on the higher frequency channels is more severely limited in range by trees and terrain obstructions than is true on lower frequencies. The successful net on 38.5 megahertz may fail when switched to 65.1 megahertz. Rain, fog, and condensation on the foliage also limit range.

The LOS constraint leads to other problems. Consider a net with ten stations spread over a brigade sector. Every net station should have LOS with the net control station (NCS). But the net members will not have LOS with all the other net stations. If stations A and B can't hear each other, then station B may transmit (thinking the channel is clear) while station A is transmitting. Such interference is often unavoidable. Delays result.

Capacity is the second prime limitation of FM radio nets. Let us examine a typical net. Consider a division command net with twelve stations:

1. Division G-3 (NCS at the TAC CP).
2. Commanding General.
3. Three Brigades.
4. Division Artillery.
5. Division Support Command.
6. Four Separate Battalions (Cavalry, Aviation, Engineer, and Air Defense Artillery).

7. Division G-3 (Main CP).

Only one station may transmit at a time, so the net requires discipline from the NCS. About 10% of the active net time is needed for overhead functions (net direction, frequency and crypto key changes, and communications checks). About 20% of the net time is used by the CG communicating with his commanders. Roughly 40% of the net time is used by the G-3 for broadcast messages and orders. So 70% of the net time is devoted to overhead and to downward-flowing traffic. About 20% of the net time is available for the major commands to transmit reports and requests. The five colonels commanding brigades, division artillery and DISCOM share that 20%. (A major command gets only 4% of the net time!) The remaining 10% is available for separate battalions (each gets 2.5%).

This example demonstrates the obvious capacity limitation of a net, especially for upward-flowing messages. Every net member may have something important to say, but only one may transmit at a time. Severe delays result.

The numbers of this example are offered only for illustration. During periods of stability when command centers are stationary, the use of secure telephone circuits is preferred. Reducing the use of the FM nets lowers the vulnerability of the command centers to radio-electronic combat. The numbers in the example illustrate a busy net during the intense phase of combat and maneuver. In your unit the net time may be divided up in a different way. But the fundamental capacity limitation is still true. The FM nets are tenuous for upward-flowing communications.

Information must often flow upward through several nets (e.g., a spot report or request for resources), and then downward for action. The combat soldiers in the command centers contribute additional delay to the flow. A report is received, noted, posted to the map, and discussed. Action may be initiated. A decision to forward the report is taken. The report may flow upward from platoon to division, through four nets and four command centers. The delays accumulate. The downward flowing action message suffers similar delays. The impact of congestion in single channel nets is that delay compounds delay, and responsive command and control is inhibited.

Control of the immediate battle on the REFORGER exercise was accomplished on FM secure voice. FM operations were very strong. Five brigades maneuvered in a very large area. Outages to one brigade or another occurred occasionally when LOS was lost. Equipment or operator failure caused some outages. Interference was frequent. Command and fire support nets were generally stronger than other nets.[1]

The priorities of communications are listed in our doctrine as follows: (1) commander to commander, (2) fire support, (3) combat information, and (4) combat service support.[2] FM voice can succeed in providing the minimum-essential communications for the first two priorities, but not for the last two. Other means are required.

The Multichannel System

The key strength of the MChan telephone system is high capacity. Each radio link has 12 channels. A typical employment of the MChan system is shown in Figure 2. The circles represent brigade and

Multichannel System Example

25 Links

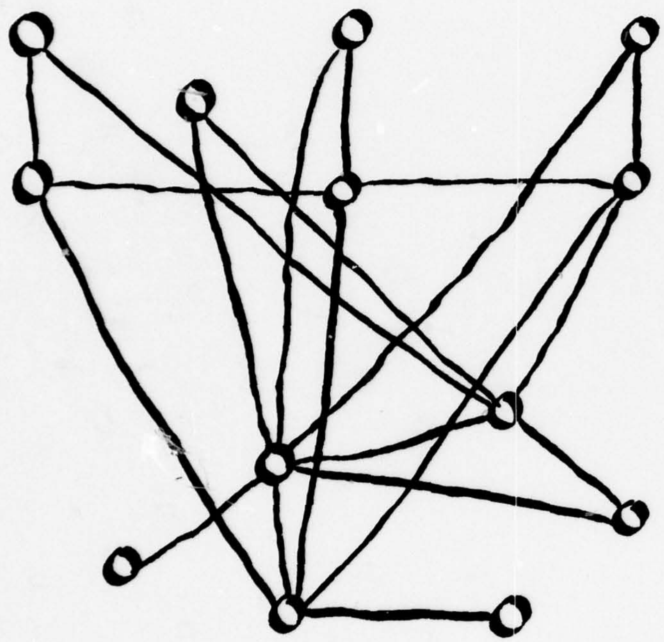

FIGURE 2

division-level command centers. The lines illustrate the interconnecting MChan radio links. The diagram shows the system during a stationary period. During the movement of a command center the links connecting that command center are broken.

A telephone circuit between two users passes over wire and cable, through switchboards, through patch panels, and over radio links. The circuit may traverse several radio links and pass through intermediate nodes. If the pathway is broken at any point, the circuit fails to work.

The dominate limitation of the MChan system is its complexity. Circuits are disrupted during movement. The LOS constraint is key, because each signal node associated with a command center must gain mutual LOS with several other nodes. A few radio relays are available to bridge gaps when LOS is not possible.

Consider the circuit example of Figure 3. The telephone circuit connects the G-3 at the division TAC CP to the S-3 at brigate. The circuit passes through one relay and one intermediate signal center (division Main). Eleven communications teams are responsible for this circuit path. If any team fails, the circuit fails. The circuit depends on the training proficiency of the signal soldiers along the path and on the reliability of the radio and power equipment. The circuit passes over WD-1 wire and over cable (installed and maintained by team 1), through the patch panel (team 2), over the MChan radio (team 3), through the relay (team 4), over the MChan radio (team 5), through the patch panel (team 6), through the switchboard (team 7), over cable (team 8), over the MChan radio (team 9,

Circuit Example

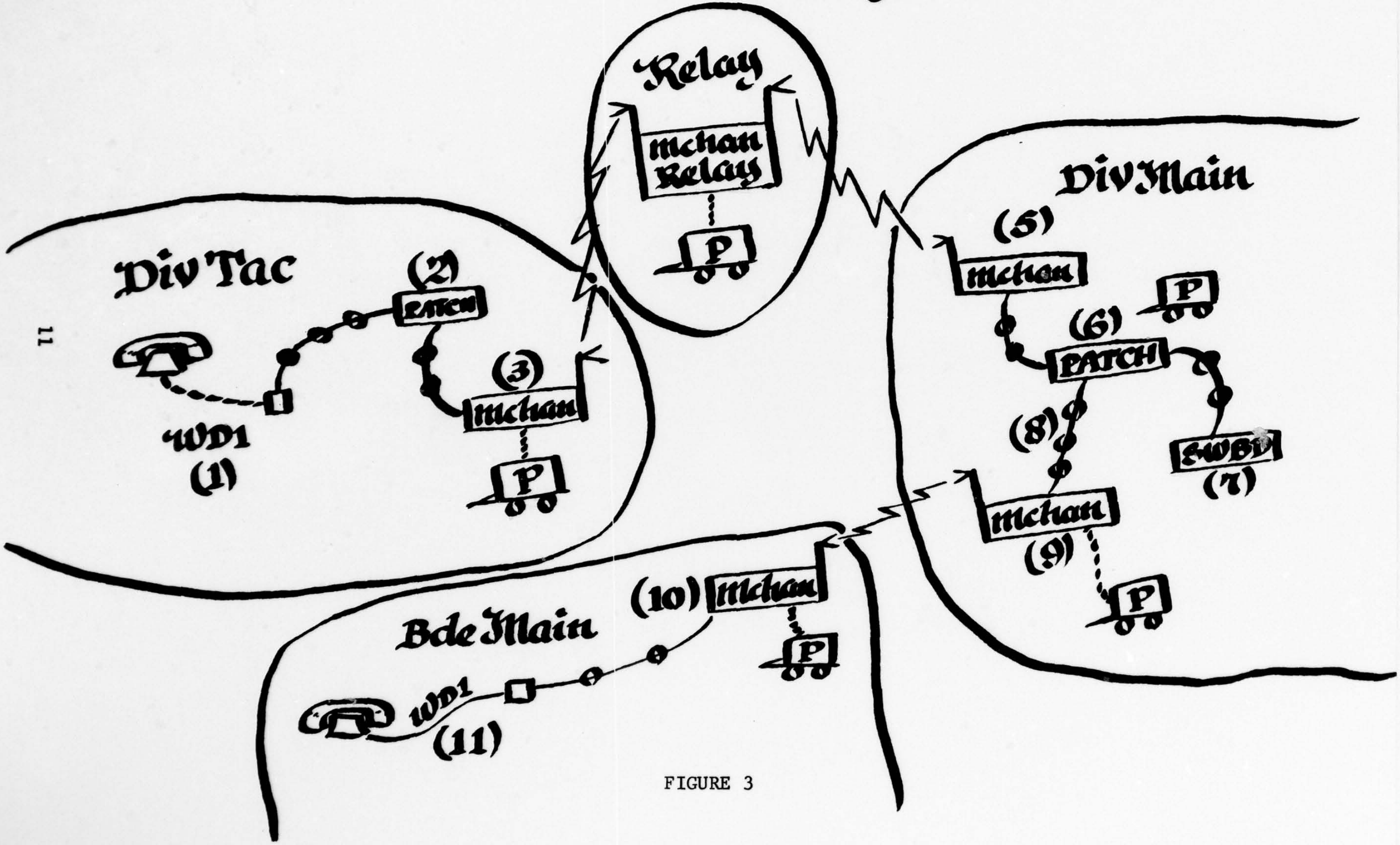

FIGURE 3

then team 10), and finally over cable and wire (team 11).[3]

Eleven signal teams share responsibility. Suppose the probability of success of each team is 90%. Then the probability that the circuit works is

$$(0.9)^{11} = 0.31.$$

The circuit works only 31% of the time! If the probability of the team success were 96%, then

$$(0.96)^{11} = 0.64.$$

The circuit works 64% of the time. This performance is during a period of stability. Additional outages are caused by movement.

Consider the movements during a typical 72-hour period: Division Main moves once (12-hour outage). Division TAC moves twice (2 X 6 = 12-hour outage). Brigade Main moves three times (3 X 4 = 12-hour outage).[4] So the total outage on the circuit is between 24 and 36 hours, depending on whether any displacements overlap in time.

So what is the circuit availability considering both displacements and team success? Using the optimistic numbers, displacement outage is 24 hours. During the 48 hours of stability the availability is 0.64 X 48 = 31 hours. So the availability factor is 31/72 = 0.43. The circuit works only 43% of the time, and that is when things are going well! The staff officer at the division TAC who complains that he can't talk to the brigades by secure phone half the time is right.

What availability is achieved in the pessimistic case? Displacement outage is 36 hours. During the 36 hours of stability the circuit works 0.31 X 36 = 11.2 hours. The availability is only 16%.

This example serves to emphasize the fragile nature of the MChan system. LOS is essential, so that command centers must locate on dominate terrain features. The frequent displacements of command centers generate an absolute upper bound on circuit availability. The system is complex, so that one failure in a serial tandem of links results in circuit failure.

The word system is defined as follows:

> 1. Orderly combination or arrangement, as of parts or elements, into a whole; specifically, such combination according to some rational principle; any methodical arrangement of parts.
>
> 2. The connection or manner of connection of parts as related to a whole . . . .
>
> 3. The state or quality of being in order . . . .

The communications system does require the "orderly combination . . . of parts . . . into a whole." The "methodical arrangement" of communications links to fit the terrain to interconnect command centers is the function of signal soldiers. The orderly movement of command centers to make such interconnection possible is one function of combat soldiers.

Notice that the antonyms for system are "chaos, confusion, derangement, disorder, irregularity," words which describe the nature of mechanized operations during the fast-moving maneuver of intense combat. A key limitation of our system is that the availability of multichannel telephone service diminishes dramatically when orderly movement of command centers is not achieved.

Another aspect of the complexity of the MChan system is the very decentralized nature of signal units. The eleven teams in

the example belong to five different platoons in four different companies (three in the signal battalion and a brigade headquarters company). The soldiers on the teams are trained in four different specialties. Great teamwork and coordination are necessary.

If 10% of the tanks in an armored battalion fail, the unit retains about 90% of its mission capability. But if 10% of the teams in the signal battalion fail, the effectiveness of the multichannel system may drop to 50%, or less. There is an avalanche failure effect. During periods of intense maneuver, the system begins to come apart, then the rate of failure accelerates to become catastrophic. Such failure occurs because the signal battalion depends on multichannel for internal command and control (C^2). As more circuits fail, the ability to control restoral is diminished. The system crashes down. System restoral is painfully slow until stability is reached.

Multichannel circuits were available in my division about 60% of the time during the REFORGER 77 exercise. Command links to the Brigade CPs were available much of the time, with outages during and following displacements. In the relative chaos of fast-moving maneuver, brigade and division artillery command posts were sometimes relocated quickly to respond to a new mission or a changed enemy situation. The rapid movements would not permit a suitable reconnaissance to be performed. So command posts were sometimes moved to locations which did not permit multichannel communications, due to LOS obstructions or heavy tree cover.

Our present MChan equipment is complex and inflexible. The antenna systems are tedious to install and lack the height (50 feet maximum) to be versatile in the heavy forests of Germany. Even if a hilltop provides the potential for LOS, the trees often tower to 80 to 120 feet. In this case, the MChan terminals must be spotted on a tree line (on the appropriate quadrant of the hilltop) to permit a clear take-off view for the LOS path. The implications of this constraint are dramatic. If LOS access is required in several directions, the terminals must be sited in several quadrants on the treeline. The forest is often too big to permit clear LOS take-off and acceptably short spans of cable to interconnect the signal center. Careful, methodical reconnaissance and detailed site layout are required to provide a signal center that works.

Several diverse factors impact on the potential for success of the MChan system which are essentially beyond management. Frequency interference and propagation anomolies are two such factors. The dominant factor is the autonomy and initiative of maneuver of the major commands. The decision on when and where to move a command post is influenced by many factors. The communications considerations are often outweighed by more urgent ones, or are overtaken by events which make planning impossible, or are simply ignored. The flow of battle changes quickly, and the maneuver plan is revised and executed quickly. But the orderly process of reconnaissance, site selection, and system planning cannot keep pace.

Brigade command posts sometimes are moved towards a map-selected "goose egg" or towards one of several sites before

reconnaissance is complete. The tentative choice of a CP location is often overturned because the site is already occupied, or is otherwise unsuitable. A new site is sometimes occupied in darkness or in such haste that the MChan terminal is positioned on the wrong side of a hill or is imbedded deep in a forest. During a series of movements a command post may "hunker in," pull into a woodline for a few hours of sleep. Such displacements interrupt signal planning and often doom the MChan links to many hours of outage.

Message Traffic

Radio teletype (RATT), communications center teletype, and ground (and sometimes air) messenger service are available in the division communications system. Teletype means suffer capacity limitations, while messenger service is very slow. A key disadvantage is that the user does not know if or when his message was delivered.

RATT nets suffer the same basic capacity limitation that is true of FM nets. One message at a time. And the upward-flowing traffic must compete for net time. Division SOPs often call for written reports from all major commands "as of 1600, due at 2000." A staff officer at each command collects the input, drafts the message, and passes the form to the RATT team. The RATT operator must log the message, type it up, wait for open net time to request to pass the message, wait his turn if more urgent traffic is pending on the net, then transmit the message. Upon receipt at the distant end, the message is logged in, then delivered by foot courier.

The potential for delay is obvious. Six to ten such routine messages are offered to the net during a short 60-90 minute time window. If urgent traffic is present on the net, the reports will be late.

RATT offers several strengths. LOS is not required. Secure page copy is provided. And rapid installation is possible (less than 30 minutes). On the debit side, the equipment is complex, difficult to maintain, and quite vulnerable to operator mistakes. The range and reliability of a RATT net are very sensitive to interference, noise, and shifting propagation conditions. The dominant limitation is capacity.

The teletype circuits which interconnect the communications centers of the division pass over the MChan system. Hence the weakness, the circuits have low availability.

Messenger service can handle great volumes of written material. But the service is very slow. Delays are most severe when command centers are moving.

In my experience the message traffic capabilities in the division system are little used. Users are reluctant to offer message traffic to the system.

Tactical Communications--A Precious Resource

The limitations of our tactical communications are profound. The weaknesses that cause failures in the MChan system or overload of the nets exist during the most stressful period of rapid maneuver and intense combat. The communications resource is most available

during intervals of stability, when we need it least. The resource is least available during movement, when we need it most.

The expectations of combat soldiers are often unrealistic. In garrison we enjoy telephone communications of perfect reliability. The diagrams of communications nets and systems that appear in our how-to-fight manuals and in our operations orders illustrate the stationary case--when units are stable. But the reality is that during the intense phase of operations, our nets are so congested that only the most urgent combat information may be conveyed. And maneuver dramatically degrades the MChan system. Thus, communications becomes the limiting capability on the overall effectiveness of our combat formations.

At another extreme, some combat soldiers with experience in wide-ranging exercises such as REFORGER are convinced that the MChan system can't be made to work. So why bother? Such an attitude leads to indifference to the considerations of LOS and orderly movement that are necessary to make the system work.

Another cop-out which avoids the responsibility for communications is summarized in the statement "It is not my problem, it is a signal problem." This attitude avoids the fact that reliable communications is an inherent and necessary element in the total mission. In doctrine the responsibility for communications is higher-to-lower. But the subordinate units must maneuver in a manner that continuous communications may be achieved.

An unfortunate lesson of our Vietnam experience is that FM voice is sufficient to control and support our operations.

That lesson may have been true then, but is not true now. The combat information and the combat service support functions must have teletype and MChan telephone to succeed. To achieve the multiplier effect of our weapons systems, we must achieve reliable communications for intelligence and logistics functions.

<u>What Can We Do Now</u>?

The first step is to gain an improved understanding of the key limitations of our communications system. Then we may act to conduct operations in a manner that minimizes the impact of the limitations. The division commander can clearly define the joint responsibility that commanders, staff officers, and the signal officer bear for reliable communications. Division level training can be intensified to stress the difficult task of maintaining continuity of C^3 during movements of command centers. We can train to discipline our use of the limited communications resource. Reporting requirements can be simplified and reduced to match the combat needs and the realities of limited communications. We can simplify the structure of our C^3 to enhance the continuity of operations during intense combat. Finally, we can adapt our tactics to match what is possible to accomplish with C^3.

What simplification in structure may be helpful? By doctrine, a maneuver brigade operates three headquarters echelons: TAC, Main, and Trains. The coordination of orderly movement of three echelons seems to be virtually impossible during fast-moving wide-ranging maneuver. One solution is to consolidate the Main and the Trains.

Colocation enhances the depth of staffing by brigade staff officers, strengthens the continuity of planning and operations, and increases the density of communications resources. Keeping the combined command center stable improves the continuity of C^3 and of support operations. If the C^3 element of the command center is positioned on a dominant hill top in the brigade sector, the CP can provide LOS overwatch to permit reliable communications to the battalions and the TAC CP, and rearward to the division. The combined Main/Trains may remain stationary for extended periods, providing continuity during the movements of other CPs.[5]

Another simplification in the division system is to operate a relatively stable signal center to support the division artillery. The idea is to connect the CP to the signal center by one MChan radio or cable link. The signal center is held stationary during two or three moves of the division artillery CP. The stability enhances the continuity of the signal center as a division alternate communications node. The signal center must remain stable during movements of the division Main to provide links to the division TAC and upward to the corps. The additional link to division artillery does reduce reliability, but the gain in availability due to the stability of the signal center more than offsets the loss. There is nothing new in this idea. Current doctrine calls for a "down-the-hill" radio or cable link for division artillery. The key point is that there is real benefit to holding the signal center stable.

The approach suggested for the division artillery is not useful to apply to other command centers. To position the signal

center on the hilltop and the command post in a village or in less vulnerable terrain is in general disruptive. The reasons are several. The down-the-hill radio or cable link decreases voice quality, decreases reliability due to the increased complexity of every circuit, and reduces availability because of the additional installation time. Division Main is much too complex a signal node to operate reliably in a "down-the-hill" mode. The coverage of the FM radios is sharply reduced if operated from the village rather than the hilltop. The signal platoon is less effective because the resources are split in two locations. Finally, it takes more signal resources to operate "down-the-hill." The resources are not available unless other parts of the system are eliminated.

A more drastic approach to simplify the MChan system is to connect the system only to the center brigade. The signal battalion resources that are normally employed with the two-flank brigades become available. These signal platoons could be used to provide displacement signal centers for the division artillery and the division Main.

The challenge facing us today is how can we succeed in combat with the limitations of our present communications system. I believe we must become more aware of the limitations of LOS, movement, and capacity, and work hard to simplify and discipline the structure of our command and control communications. The integrity of our tactical combat force is in serious trouble today because of the weakness in tactical communications.

The Future

The satellite radio capability to be fielded in the 1980s will dramatically offset the LOS limitation. Rapid installation will partially offset the movement limitation. Satellite links will help, but won't solve our problem.

The new family of single channel radios to be fielded will improve the hardware reliability and decrease the vulnerability to interference and enemy electronic warfare. But the LOS and capacity limitations will remain.

Automatic switching will improve the speed of telephone service. But the availability of terrestrial MChan circuits will remain limited by LOS and movement.

Computer-based command and control systems are being fielded at a rapid pace. TACFIRE, TOS, and MISSILE MINDER are three systems that will dominate division level C^2 in the 1980s. The digital signals which must flow between the computer nodes of these C^2 systems present a dramatic jump in the communications requirements. The need is for continuous, reliable data circuits. The present communications system is guaranteed to fail.

The new C^2 systems were developed with one unfortunate assumption. That is, that the C^2 system must work in the existing voice communications network. Why couldn't we have been smart enough to develop an integrated C^3 system?

Major General William J. Hilsman recently described the battlefield of 1985 and beyond as possessing three key characteristics:

1. High technology.

2. A Large number of processors embedded in the weapons systems.

3. An absolute dependence on communications to make the weapons systems work.[6]

Now the challenge is to develop and field a data distribution system that is reliable and robust during maneuver. And, we must modify the software (and perhaps some of the hardware) in the C^2 systems to function in a data communications network.

What about other new requirements? The "smart bombs" and precision guided munitions now in development are certain to impose new communications needlines. Over the horizon tank-killers such as the "Assault-Breaker" concept will add to the demand for very responsive communications of almost perfect reliability. The Forward Observer who has requested a Copperhead fire mission on inbound tanks must be told when to laser designate the target. That message ("Do it now.") must get through <u>now</u>.

General William E. Depuy stated the communications challenge for the 1980s as follows:

> What is required is a combination of streamlined operational and intelligence procedures supported by multiple access communications and distribution systems. Critical combat information must be moved in near-real time--intelligence based on correlation and fusion of that information as soon thereafter as possible. There is no reason why such a system cannot be developed, procured, deployed and put into operation so that our brigades and battalions, properly concentrated and supported, can "be there waiting."[7]

The present communications system falls well short of the need. The future system may fail (in its day) to meet pressing needs.

We must build a system that is robust and rugged in the environment of intense combat. We must overcome the limitations of LOS, movement, and capacity. We need a distributed, integrated network with flexible user access and signal nodes that are offset from command centers.

NOTES

1. A single-channel voice satellite net was employed with stations at division Main, TAC, and the two flank brigades. The satellite net was the most responsive and reliable means. Such performance is true because of the terrain independence of siting a satellite terminal. The terminal only needs LOS in a skyward direction towards the satellite.

2. FM 101-5, Operations, 1 July 1976, p. 3-16.

3. This circuit is an actual one used in my division. The secure circuits all connect to one switchboard at the division Main.

4. We assume in this example that the outages due to tear-down, movement, and set-up for division Main, division TAC, and brigade Main are twelve, six, and four hours respectively.

5. A trade-off is at work here. The combined CP has increased physical signature. And stability prolongs the electronic signature. On the other hand, the stability permits improved C^3 and support operations.

6. William J. Hilsman, "C^3I Communications Vital in Integration of the Force-Multipliers," Army Magazine, March 1979, p. 36.

7. William E. Depuy, "Technology and Tactics in Defense of Europe," Army Magazine, April 1979, p. 16.